BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 2 OCTOBER 1954 PART 14

INSTITUTE NEWS

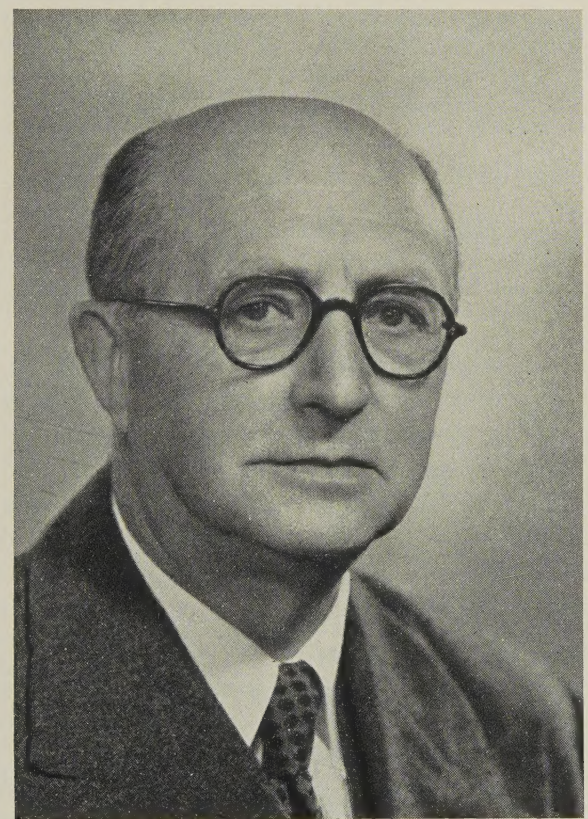
Election of New Fellow

The Council has elected Mr. H. S. TASKER (Past-President) a Fellow of the Institute in recognition of his long and distinguished services. The number of Fellows is limited to twelve, and Mr. Tasker's election brings the present total to ten.

Hubert Sanderson Tasker was born in 1885 and educated at King Edward's School, Birmingham, and Emmanuel College, Cambridge (Scholar). He joined the staff of Cookson and Company, Ltd., Newcastle-upon-Tyne, in 1910, and became a Director of the Company in 1920.

In 1927 he was appointed Managing Director of Associated Lead Manufacturers, Ltd., and subsequently Managing Director of Goodlass Wall and Lead Industries, Ltd., on the formation of that Company in 1931. He became Vice-Chairman in 1940 and was Chairman from 1947 to 1951. He is also Chairman of the British Titan Products Co., Ltd.

Mr. Tasker was a Vice-Chairman of the British Non-Ferrous Metals Research Association from 1935 to 1951. He was elected a member of the Institute in 1933, and served as a Member of Council from 1938 to 1942, as a Vice-President from 1942 to 1945 and again from 1948 to 1950, and as President for the year 1950–51. He was Chairman of the Finance and General Purposes Committee from 1940 to 1944, and from 1945 to 1947 was Honorary Treasurer, in which capacity he performed outstanding service to the Institute.



H. S. TASKER, ESQ., B.A.

Spring Meeting 1955

The Annual Spring Meeting of the Institute for 1955 will be held in London from Tuesday, 29 March to Friday, 1 April.

The meeting will begin with the May Lecture on the evening of Tuesday, 29 March. The Annual General Meeting for transaction of business, award of medals, &c., will take place on the morning of Wednesday, 30 March, and will be followed by the Address of the incoming President, Dr. Maurice Cook. A selection of papers previously published in the *Journal* will be discussed in the afternoon, and the next day will be devoted to a Symposium on " The Control of Quality in the Production of Wrought Non-Ferrous Metals and Alloys. III.—Control of Quality in Heat-Treatment and Final Operations." A further selection of papers will be discussed in simultaneous session.

The Annual Dinner-Dance will be held on the evening of Thursday, 31 March, and works visits are being arranged for Friday, 1 April.

Further details will be published in a later issue.

Informal Discussion on " Non-Metallic Die Materials "

An Informal Discussion on " Non-Metallic Die Materials " is being organized by the Metallurgical Engineering Committee. It will be held at the University, Edgbaston, Birmingham 15, on Wednesday, 16 February 1955, beginning at 10.30 a.m. Lunch will be available in the University Refectory, and the meeting will continue in the afternoon.

Students' Essay Prizes 1954

Regulations

The Council will present two prizes of twenty-five and fifteen guineas, respectively, for the two best essays submitted in accordance with the regulations set out below. Half of each prize will be in the form of money and half in the form of scientific, technical, or other appropriate types of books, to be selected by the prizewinner. If of sufficient merit, a prize-winning essay may be published in the Institute's *Bulletin* or selected for reading before a Local Section.

(1) *Eligibility.*—The competition is open to all Student Members of the Institute, and to all Associate Members of Local Sections who are eligible for Student Membership of the Institute, provided that both are within the normal age limits for Student Membership, viz. 17 to 25 years. The competition is not restricted to persons who are undergoing courses at a University or Technical College; it is open to all persons within the age limit stated. A prizewinner will be ineligible to take part in the competition in the year subsequent to that in which he or she submitted a winning essay.

(2) *Language.*—Essays must be submitted in English.

(3) *Length.*—Essays should be 2500–3500 words long and must not exceed 3500 words. They must be submitted in typewritten form with double-line spacing.

(4) *Subject.*—The choice of subject is left to the competitors, except that subjects relating exclusively to extraction or ferrous metallurgy are ineligible. The subject matter should be logically presented, in good English, and *should have a metallurgical content to impress the adjudicators by soundness, exercise of critical faculty, and originality of approach.* No prize will be awarded if the essays do not, in the opinion of the adjudicators, reach the requisite standard.

(5) *Method of Submission.*—Each entry must be submitted to The Secretary, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, not later than 1 January 1955 and must be accompanied by a certificate, signed by the entrant, that the essay itself is entirely his or her own work, that it has not, in the form in which it has been sent, been submitted for any other competition, and clearly stating what (if any) drawings, photographs, &c., have been prepared on his or her behalf.

(6) *Presentation of Prizes.*—The prizewinners will receive their prizes from the President, when he presents the Medals awarded by the Institute, at the 1955 Spring Meeting.

Monograph No. 2: " Constitution of Alloys Bibliography "

" The Bibliography of the Literature Relating to Constitutional Diagrams of Alloys," compiled by Dr. J. L. Haughton and published in 1942, with a small supplement in 1944, has been out of print for several years. In view of the very considerable volume of constitutional work that has appeared since the war, the Publication Committee feels that a new and up-to-date edition would be welcomed by many members.

It is the Institute's intention, therefore, to issue next year a new edition which will include references to work published, at least in the main journals where constitutional papers are to be found, up to the end of 1954.

In the preparation of the new edition, it would be very valuable if members who have had occasion to use the Bibliography extensively would inform the Editor of any errors or omissions they have found in the first edition or the Supplement. Would such members kindly write, therefore, to the Editor, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, before 31 December 1954, so that their additions and corrections may be incorporated.

Election of Members

The following 8 Members were elected on 1 September, 1954:

BURTON, George Kenneth, Director, Despo Manufacturing Co., Ltd., 30 Pancras Road, London, N.W.1.

FERON, Denis, Ing.Civil Mines, Ingénieur, Société Industrielle de l'Aluminium S.A. (SIDAL), Duffel, Belgium.

HARVEY, Lawrence A., B.A., LL.B., M.B.A., President, Harvey Aluminum, 19200 South Western Avenue, Torrance, Calif., U.S.A.

KENNEDY, James Melvin, LL.B., Chairman of the Board, Revere Copper and Brass, Inc., 230 Park Avenue, New York 17, N.Y., U.S.A.

KLINCK, Ronald Woodard, B.A., M.A.Sc., Head, Division of Engineering, British Columbia Research Council, University of British Columbia, Vancouver 8, B.C., Canada.

KRAMER, Irvin R., M.S., D.Eng., Metallurgist, Mercast Corp., 295 Madison Avenue, New York 17, N.Y., U.S.A.

RUTHERFORD, John J. B., Chief Metallurgist, The Babcock and Wilcox Company, Tubular Products Division, Beaver Falls, Pa., U.S.A.

SUTHERLAND, William Henry Daniel, Inspection Engineer, Engineering Department, Inspection Section, Imperial Chemical Industries, Ltd., 32 Deansgate, Manchester.

Abstractors Required

The Editor would be glad to hear from Members who would be prepared to assist in the preparation of " Metallurgical Abstracts ". Those with a knowledge of languages and access to a good technical library will be particularly welcome.

PERSONAL NOTES

Dr. J. B. Austin has been appointed a Vice-President of the United States Steel Corp., with special responsibility for fundamental research.

Mr. D. W. C. Baker has left The Mond Nickel Co., Ltd., to join the staff of the Tin Research Institute.

Mr. J. W. Bentley has joined the Liaison Department of the British Non-Ferrous Metals Research Association.

Mr. Howard Biers, New York consulting engineer, has been awarded the degree of Dr. mont. (Doctor of Mining and Metallurgy) of the Montanistische Hochschule, Leoben, Austria. Earlier this year Mr. Biers was formally elected President of the International Institute of Welding.

Mr. J. W. H. Clare has left Birmingham University, where he recently obtained an honours degree in Physical and Theoretical Metallurgy, and is now with Aluminium Laboratories, Ltd., Banbury.

Dr. A. E. El-Mehairy has returned to Egypt to take up an appointment with the Ministry of Commerce and Industry, Cairo.

Mr. R. P. H. Fleming has left the Nelson Research Laboratories of the English Electric Co., Ltd., Stafford, and has become Chief Metallurgist to Dexion, Ltd., London, N.W.6.

Dr. P. Greenfield is now working in the Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

Mr. G. Hartland-Garrett has been appointed Metallurgist to Allcock and Co. (Metals), Ltd., Birmingham.

Dr. J. B. Haworth has left the British Columbia Research Council, having accepted a post as research metallurgist with Sherritt Gordon Mines, Ltd., Fort Saskatchewan, Alberta.

Mr. K. Headlam-Morley, Secretary of the Iron and Steel Institute, was recently honoured by the King of Sweden with the insignia of Chevalier (Riddare) of the Order of Vasa in recognition of his contribution, within the Institute's field of action, towards the promotion of friendly relations between the British and Swedish Iron and Steel Industries.

Mr. J. F. B. Jackson has relinquished his post as Director of the British Steel Castings Research Association to join the board of A.P.V.-Paramount, Ltd., Crawley, Sussex, as Deputy Managing Director.

Mr. R. Jay has left the British Non-Ferrous Metals Research Association to join The British Aluminium Co., Ltd.

Mr. D. H. Kirkwood has been awarded a scholarship by the British Oxygen Co., Ltd., tenable for two years in the Metallurgy Department at Cambridge University.

PAPERS FOR THE INSTITUTE JOURNAL

NOTICE TO PROSPECTIVE AUTHORS

The high cost of printing, paper, and binding, coupled with the large number of manuscripts now being received, force the Publication Committee to insist on conciseness in the presentation of papers submitted for the *Journal*. In future, the Committee will consider and accept only manuscripts that are concisely written, well presented, and illustrated with the minimum possible number of diagrams and photographs. Economy is specially necessary in regard to half-tone illustrations, as the printing and binding of plates represent particularly heavy items in the cost of producing the *Journal*.

It is the general opinion of members of the Committee and of referees that few papers are submitted that could not have been written more succinctly. In this connection the Committee wishes to emphasize that theses and reports prepared for circulation within an author's organization are very rarely in a form suitable for submission as papers to be published by a scientific society. Such manuscripts normally need very critical examination, and thorough revision, before they are submitted for consideration by the Publication Committee, and the Committee looks to heads of laboratories from which many of the papers published in the *Journal* come, to ensure that this is done. In the past authors have all too frequently left to referees or to Committee members the task of suggesting how papers might be revised and made acceptable for the *Journal*.

Mr. F. L. LaQue has been elected a Vice-President of the International Nickel Co., Inc., New York. He will continue to serve as Manager of the Company's Development and Research Division.

Mr. Donald McDonald, Chairman of the Executive Committee of the Board of Johnson, Matthey and Co., Ltd., since 1930, retired on 31 August after 44 years' service with the Company.

Mr. J. S. Morton has been appointed a Director of Electro-Chemical Engineering Co., Ltd., Weybridge.

Dr. P. Samuel has left the Research Department of Hadfields Ltd., to become Senior Lecturer in Metallurgy at Sheffield College of Commerce and Technology.

Dr. I. G. Slater has relinquished his position as Director of Research and Development to T.I. Aluminium Ltd., to become Head of the Metallurgy Department at Birmingham College of Technology.

Mr. V. N. Whittaker has left Manchester University to take up a research post at Birmingham University.

Mr. J. C. Wright, of the Development and Research Department of The Mond Nickel Co., Ltd., has been awarded the B.Sc. (Engineering) Metallurgy degree of London University, with first-class honours.

Deaths

The Editor regrets to announce the deaths of:

Mr. Edmonds Frank MacTaggart, until recently Director of Sondes Place Research Institute, Dorking, on 27 August, aged 49.

Mr. Frank Mason, Technical Director of Stainless Plating, Ltd., Sheffield, on 20 August, at the age of 77. He had been a Member of the Institute since 1910 and was Chairman of the Sheffield Local Section from 1938 to 1947.

LETTER TO THE EDITOR

Non-Equilibrium Structures in a Titanium-Base Alloy

Whereas martensitic and equilibrium structures in iron–carbon alloys may be easily differentiated under the microscope, a lack of familiarity with similar structures in other binary alloys often makes their recognition difficult. Doubts sometimes arise as to whether a structure is a fine Widmanstätten precipitate (indicating a diffusion process and an approach to equilibrium) or a geometric pattern of strain lines (suggesting diffusionless reactions).

Such difficulties are encountered with structures produced in titanium-base alloys; and presumably they will be overcome only when—and if—the metallographer's experience of these alloys is widened.

In relation to these facts, we feel that the accompanying photomicrograph (Fig. A.) may be of interest. It is of a needle specimen of a 2·2 at.-% iron alloy with titanium, air-cooled (sealed *in vacuo* in a silica tube) from 1000° C. Under these circumstances cooling was sufficiently slow to permit some hexagonal α phase to precipitate from the body-centred cubic β phase. However, the temperature fell past the M_s temperature at a rate sufficiently rapid to allow most of the remainder of the β structure to transform martensitically to hexagonal α′. An X-ray-diffraction photograph showed broad lines of hexagonal structure (α and α′), and extremely faint β lines. In the photomicrograph, the α produced by diffusion processes appears as the black Widmanstätten constituent, while the martensitically produced material is revealed as a geometric pattern of strain lines.

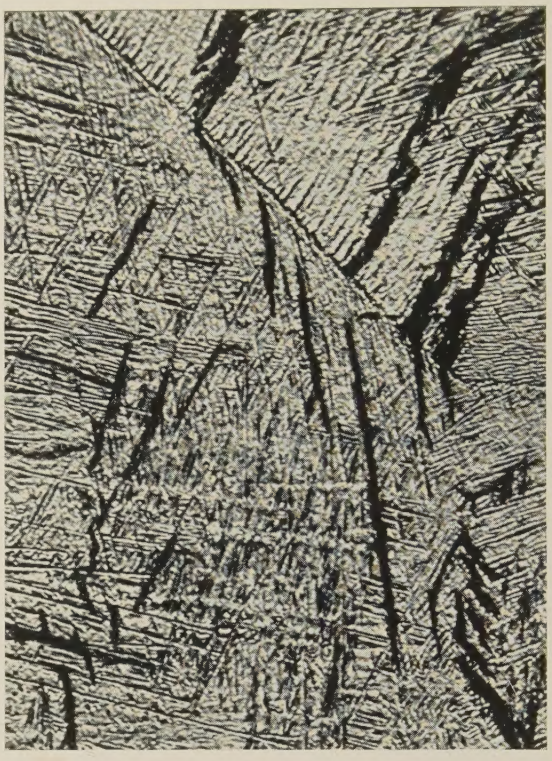


Fig. A.—Titanium–2·2 at.-% Iron Alloy, Air-Cooled from 1000° C. Etched in 1% HF + 1% H_2O_2 in water. × 700.

As one would expect, precipitation and shear are in similar directions. Further, some of the streaks of precipitate appear to have been "kinked" by the subsequent shear process.

D. H. Polonis
J. Gordon Parr

Department of Mining and Metallurgy,
University of British Columbia,
Vancouver, B.C., Canada.

JOINT ACTIVITIES

Symposium on Powder Metallurgy

The following is the complete list of papers for the Symposium on Power Metallurgy, to be held by the Iron and Steel Institute, in association with the Institute of Metals, at Church House, Great Smith Street, London, S.W.1, on Wednesday and Thursday, 1 and 2 December 1954:

Group I.—Manufacture, Properties, and Testing of Powders

"Metal Powders for Engineering Purposes—A Review", by W. D. Jones; "The Grinding of Metal Powders", by

G. F. Hüttig and H. Sales; "The Production and Fabrication of Tantalum Powder", by R. Titterington and A. G. Simpson; "The Powder Metallurgy of Zirconium", by F. G. Cox and G. L. Miller; "Powders for Magnetic Applications", by G. R. Polgreen; "Recent Developments in Testing Metal Powders", by G. R. Bell; "Application of Particle-Size Analysis to the Quality Control of Metal Powders", by V. T. Morgan; "Determination of the Gas Contents of Materials of Powder-Metallurgy Practice", by H. A. Sloman; "Factors Influencing the Reactivity of Solids, with Particular Reference to Metals", by J. A. Hedvall.

Group II.—Principles and Control of Compacting and Sintering

"The Mechanism of Infiltration", by P. Schwarzkopf; "The Sintering Mechanism of Pure Metals, Including 'Activated Sintering'", by M. Eudier; "The Variation of Thermo-Electric Force During Sintering", by G. Ritzau; "The Designation of Powders and Sintered Materials by Means of the Properties of the Pore Volume", by K. Torkar and G. F. Hüttig; "Pore-Size Distribution and Permeability of Porous Metal Materials", by P. R. Marshall; "Filter Elements by Powder Metallurgy", by V. T. Morgan; "Relationships Between the Properties of Iron Powders and Powder Compacts", by F. V. Lenel, H. D. Ambs, and E. O. Lomerson, Jr.; "Pressing Characteristics of Air-Atomized Copper Powder", by A. Duffield and P. Grootenhuis; "Grain Growth During Sintering", by H. H. Hausner; "The Hot Compacting of Metal Powders", by J. Williams; "The Hot Pressing of Ceramics", by P. Murray; "The Continuous Compacting of Metal Powders", by P. E. Evans and G. C. Smith; "Effect of Small Boron Contents on the Properties of Sintered Bodies Prepared by Vacuum Sintering", by F. Frehn and W. Hotop; "Sintering-Furnace Atmospheres", by L. D. Brownlee, R. Edwards, and T. Raine.

Group III.—Manufacture and Properties of Structural Engineering Components

"Some Developments in Sintered Structural Parts", by C. J. Leadbeater; "Experiments on the Production of High-Strength Material and Parts by Powder Metallurgy", by L. Harrison and S. Marton; "Sintered Nickel Steel and Notes on Other Sintered Alloys", by S. C. Wilsdon and P. J. Ridout; "Solid Stainless-Steel Compacts from 18 : 8 Austenitic Powders", by B. Sugarman; "Porous Stainless Steel", by D. A. Oliver, S. C. Wilsdon, P. R. Marshall, B. Sugarman, G. Collins, and C. T. J. Jessop; "The Porosity and Air Permeability of Sintered Iron and Iron–Copper", by C. J. Leadbeater and S. Turner; "Low-Expansion Nickel–Iron Alloys Prepared by Powder Metallurgy", by V. Thomas and D. J. Jones; "Application of Powder Metallurgy to the Production of High-Permeability Magnetic Alloy Strip", by E. V. Walker, D. K. Worn, and R. E. S. Walters; "Fatigue Properties of Sintered Copper Compacts", by O. J. Dunmore and G. C. Smith; "Production of Sintered Copper–Lead Bearing Material", by W. E. Duckworth; "Properties and Testing of Sintered Copper–Lead Bearing Materials", by P. G. Forrester and W. E. Duckworth; "Fluon-Impregnated Self-Lubricating Bearing Materials", by A. Blainey; "Sintered Aluminium Powder", by R. Irmann; "Preparation of High-Modulus Aluminium Alloys by Powder Metallurgy", by N. F. Macdonald and C. E. Ransley; "Powder Metallurgy of Magnesium", by D. J. Brown.

Group IV.—Powder Metallurgy of High-Melting-Point Materials

"Developments in High-Density Alloys", by E. C. Green, D. J. Jones, and W. R. Pitkin; "The High-Temperature Strength of Some Co–Ni–Fe–Cr-Base Materials Made by Powder Metallurgy", by G. T. Harris and H. C. Child; "Preparation and Properties of Titanium and Titanium Alloys Prepared by Sintering", by D. A. Robins, W. R. Pitkin, and I. Jenkins; "Sintered Titanium-Carbide Alloys", by E. M. Trent and A. Carter; "The Testing of Ceramal Materials with Particular Reference to a Simple Titanium-Carbide–Cobalt Material", by T. W. Penrice and D. H. Shute; "The Creep Strength of Titanium-Carbide-Base Materials", by G. T. Harris, H. C. Child, and J. F. Howard; "Silicides of the Transition Metals of the 4th, 5th, and 6th Groups of the Periodic Table", by R. Kieffer and F. Benesovsky; "Effect of Carbon Content on the Properties of Tungsten Carbide–Cobalt Hard Metals", by L. D. Brownlee, R. Edwards, and T. Raine; "Chromium Carbide in Hard-Metal Alloys", by J. Hinnüber and O. Rüdiger; "Metal–Ceramic Bodies", by A. E. S. White, F. K. Earp, T. H. Blakeley, and J. Walker; "Development of Metal–Ceramics from Metal–Oxide Systems", by J. R. Baxter and A. L. Roberts; "The Rupture Strength of Some Metal-Bonded Refractory Oxides", by G. T. Harris and H. C. Child.

Preprints of the papers will be issued before the meeting, and afterwards the papers and discussion will be published in a bound volume, price £3 5*s*. (post free). In the case of orders received before the meeting, one set of preprints will be provided free in respect of each bound volume ordered. Preprints will not be supplied without an order for a bound volume.

The Symposium is open to all interested in the subject, whether members of the Iron and Steel Institute or the Institute of Metals or not. A circular giving full details of the meeting has been sent to members of the two Institutes; non-members should apply to the Secretary of the Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1, for copies of the circular and reply forms.

OTHER NEWS

The Microscopy of Metals

A series of ten weekly lectures on "The Microscopy of Metals" is to be given at the Battersea Polytechnic, London, S.W.11, beginning on 5 October 1954. The lectures, which will start at 7.0 p.m. and be followed by discussion, will embrace electron microscopy as well as light microscopy, and there will be a lecture on X-ray techniques in metallography. The fee for the course is £2 2*s*.

Pressure Die-Casting Conference

The First International Pressure Die-Casting Conference will be held at Church House, London, S.W.1, on 25–28 October. It has two principal objects: (1) to give individual die-casters an opportunity of meeting die-casters from other countries, and (2) to draw attention to the merits and versatility of the pressure die-casting process. Full details may be obtained from the Zinc Alloy Die-Casters Association, Lincoln House, Turl Street, Oxford.

DIARY

Local Sections and Associated Societies

18 October. Scottish Local Section. Visit to Renfrew Foundries, Ltd., Hillington, Glasgow.

18 October. Sheffield Local Section. "Metallurgical Problems of Atomic Energy", by L. Rotherham. (University Buildings, St. George's Square, Sheffield, at 7.30 p.m.)

19 October. North East Metallurgical Society. "The Application of Gaseous Oxygen to Open-Hearth and Converter Steelmaking", by D. J. O. Brandt. (Cleveland Scientific and Technical Institution, Middlesbrough, at 7.15 p.m.)

27 October. Manchester Metallurgical Society. "Metallurgical Problems of Atomic Energy", by Dr. H. M. Finniston. (Lecture Room, Central Library, Manchester, at 6.30 p.m.)

2 November. Oxford Local Section. "Ceramics", by Dr. J. White. (Cadena Café, Cornmarket Street, Oxford, at 7.0 p.m.)

4 November. Birmingham Local Section. "Metallurgical Research in the Electrical Industries", by Dr. Ivor Jenkins. (James Watt Memorial Institute, Great Charles Street, Birmingham 3, at 6.30 p.m.)

4 November. London Local Section. "Trends in Metallurgy", by Professor A. G. Quarrell. (The Royal School of Mines, Prince Consort Road, London, S.W.7, at 7.0 p.m.)

8 November. Scottish Local Section. "Some Metallurgical Problems in Welding Non-Ferrous Metals". (39 Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

9 November. South Wales Local Section. "Some Aspects of Creep", by Dr. J. P. Dennison. (Metallurgy Department, University College, Swansea, at 6.45 p.m.)

10 November. Manchester Metallurgical Society. "X-Rays in Metallurgical Research", by Dr. E. A. Calnan. (Lecture Room, Central Library, Manchester, at 6.30 p.m.)

Other Societies

12 October. Royal Aeronautical Society. "Behaviour of Light Alloys at Elevated Temperatures", by B. C. Gadd. (4 Hamilton Place, London, W.1, at 7.0 p.m.)

14 October. Chemical Society, Northern Ireland Section. "The Production and Properties of Titanium and Titanium Alloys", by Dr. N. P. Inglis. Joint meeting with the Royal Institute of Chemistry and the Society of Chemical Industry. (Agricultural Lecture Theatre, Queen's University, Belfast, at 7.30 p.m.)

18 October. Institution of Production Engineers, North Eastern Section. "Shell Moulding for the Production Engineer", by A. Woods. (Nevill Hall, Newcastle-upon-Tyne, at 7.0 p.m.)

20 October. Institution of Locomotive Engineers. "The Design of Light Alloy Coaches for East African Railways", by J. F. Thring. (Institution of Mechanical Engineers, 1 Birdcage Walk, London, S.W.1, at 5.30 p.m.)

21 October. Institution of Mining and Metallurgy. "The Effect of Surface Films on the Polarizing Angles of Pyrite, Coal, and Fluorspar", by P. F. Whelan and R. P. Wilkinson. "Flotation of Quartz and Felspar by Dodecylamine", by M. H. Buckenham and J. Rogers. (Geological Society, Burlington House, Piccadilly, London, W.1, at 5.0 p.m.)

28–29 October. Institute of Welding. Autumn Meeting. (Institution of Civil Engineers, Great George Street, London, S.W.1, at 10.30 a.m. and 2.30 p.m.)

APPOINTMENTS VACANT

IMPERIAL SMELTING CORPORATION, LTD., invites applications from technically qualified Metallurgists for Senior Staff vacancies existing in its Development Department and Research Laboratory. Extraction Metallurgists are required for work on problems of Pilot-Plant operation and metallurgical development, and a Physical Metallurgist for laboratory investigational work on Alloys. Applications, quoting reference IM./MET., to Personnel Manager, Imperial Smelting Corp., Ltd., St. Andrew's Road, Avonmouth, Bristol.

METALLURGICAL ASSISTANT required for interesting position in our Laboratory at Shaftmoor Lane Works. Applicants should preferably have had industrial experience. These appointments are pensionable and offer good prospects to individuals with initiative and technical ability. Applications should be sent to Personnel Manager, Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham 28.

METALLURGICAL ASSISTANT required having completed National Service. Minimum qualification Higher National Certificate. Should preferably have experience in Metallography of ferrous and non-ferrous aircraft materials, in particular heat-treated steels. These appointments are pensionable and offer good prospects to individuals with initiative and technical ability. Applications should be sent to Personnel Manager, Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham 28.

METALLURGICAL CHEMIST. Competent young analyst required with knowledge of ferrous and non-ferrous analysis and the use of modern techniques. Excellent opportunity for carrying out interesting work connected with a variety of research and development projects. The position is permanent and progressive. Some knowledge of plating an advantage. Should have completed National Service. Superannuation scheme in operation. Send full details, including salary required, to Box No. 374, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

RESEARCH METALLURGIST with good degree and experience is required to undertake work on problems associated with machining and forming of ferrous and non-ferrous materials. Knowledge of the cold working of metals would be an advantage. Surroundings are pleasant and the successful candidate will be working in interesting fields which offer wide scope. The position is permanent and progressive and carries F.S.S.U. benefits. Full details, including age, experience, qualifications, and salary required, to Box No. 372, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.